Claims

TITLE

Micro-extrusion line

CLAIMS

1. Micro-extrusion line which maintains the general principal and functionalities of equivalent industrial extrusion lines, miniaturized for allowing the production of small profiles and filaments in a continuous regimen, in a thermo-mechanical environment using only a few grams of raw material, typically 5 to 10 g, characterized in that it comprises a vertical extruder, basically consisting of a barrel (1) kept under controlled temperature, inside which an Archimedes-type screw rotates at a constant frequency, and on which a feeding hopper (13) for material discharge , an extrusion head/die (7), a cooling bath (17) and a winding system (19) are mounted, being all fixed on the same platform (22).

2. Micro-extrusion line in accordance with the previous claim, characterized in that the extruder driven by a motor (11) mounted on a column (23), through which it is capable of sliding by means of a lever (24), comprises a vertical hollow barrel (1) divided into three different zones, the top one that allows the circulation of a cooling fluid, contains two external grooves (3) covered by a ring (4) so as to create two inlet and outlet annular channels (5), the middle section, separated from the previous one by an external cross-sectional groove, which forms a thermal barrier, covered by the heating thermal resistance (6) and containing an horizontal lateral threaded hole connecting the inner cavity to the outer surface and allowing the connection to the die (7), and a lower zone that enables the fixation to the platform and is connected to a disk (8), which comprises the thermal resistance (10).

3. Micro-extrusion line in accordance with the previous claim, characterized in that vertical hollow barrel (1) of the extruder has an external diameter of 26 mm and an internal diameter between 5 and 7 mm, the top zone has a length of 20 mm, the middle section has a length between 46 and 48 mm, being separated from the previous one by an external groove with a depth of 6 mm and a height of 1 mm, the horizontal lateral threaded hole for connection to the die has diameter between 6 and 10 mm and the disk (8) a diameter of 64 mm.

4. Micro-extrusion line in accordance with claim 1, characterized in that the feeding hopper that sits on top of the extruder is a conical hopper with the larger diameter between 70 and 80 mm, comprising a body (13) threaded to the base (14) containing an annular groove close to the inner surface, which defines an annular channel (15) with inlet and outlet (16) and a base (14).

5. Micro-extrusion line in accordance with claims 1 and 2, characterized in that the Archimedes-type screw (2) presents a geometrical definition obtained considering the required performance (output, melting efficiency, pressure generated) and the main characteristics of the materials processed (viscosity levels, range of melting temperatures, thermal conductivity).

6. Micro-extrusion line in accordance with claims 1 and 5, characterized in that the Archimedes-type screw (2) has an external diameter between 5 and 7 mm and length between 90 and 130 mm, being coupled to the shaft (12) of a variable speed motor (11).

7. Micro-extrusion line in accordance with claims 1, 5 and 6, characterized in that the Archimedes-type screw has a pitch between 1 and 2 mm and five distinct zones, having variable relative length, the first (n) having constant channel depth (t_1) between 1 and 2 mm, the second (o) having variable channel depth, the third (p) having constant channel depth (t_2) between 0.3 and 0.6 mm, the forth (q) 1 to 3 mm long with no screw flight and the fifth (r) comprising three rings between 2 and 3 mm thick, diameter between 5 and 7 mm and spaced 1mm from each other.

8. Micro-extrusion line in accordance with claims 1, 5, 6 and 7 characterized in that the Archimedes-type screw can have inserted in zone (p), where the main coil was interrupted, a ring with thickness (e) between 1 and 3 mm and diameter (f) between 5 and 6 mm which determines the available area for the progression of the material to be processed, forcing it to flow at a higher shear rate.

9. Micro-extrusion line in accordance with claims 1, 5 and 6 to 8 characterized in that the Archimedes-type screw can have inserted in zone (p) a device comprising an inlet channel and an outlet channel with 2 to 3 mm wide and 10 to 12 mm long, separated by three grooves with 9 to 11 mm in length and 2 to 3 mm in width, with lateral walls (l) with height between 0.3 and 0.5 mm, and with wall (j), between the inlet and outlet channels, with height between 0.35 and 0.55 mm, defining these heights small gaps for polymer flow that is repeatedly subjected to very high shear rates.

10. Micro-extrusion line in accordance with claim 1 characterized in that the extrusion head/die (7) has two connected cylindrical bodies, the bigger one having a thread with diameter between 6 and 10 mm, with an inside hole (u) with two distinct sections, the bigger being hexagonal with equivalent diameter between 4 and 8 mm and the smaller being circular, with diameter between 0.5 and 4 mm, or rectangular with height (v) between 0.5 and 2 mm and width (x) between 2 and 5 mm.

11. Micro-extrusion line in accordance with claim 1, characterized in that the cooling bath (17) has an open rectangular box with 80x30x20 mm, two

horizontal rods (17) being fixed transversally to the inside walls 40 mm apart, which keep the extrudate submerged in the cooling fluid.

12. Micro-extrusion line in accordance with claim 1, characterized in that the winding system comprises a haul-off and winder (19), with a coil with diameter between 4 and 10 mm, coupled to a variable speed motor (20) fixed to the platform (22).

13. Micro-extrusion line in accordance with claim 1, characterized in that the rectangular platform (22) of 600x200 mm, with several holes and a vertical column (23) with 450 mm height, having a vertically adjustable support by means of a lever (24).